

Station™. The user will be told if an obstacle is blocking the communications path. The total Stratus™ Communicator memory requirement for pointing information is less than 2 Mbytes.

Finally, for Stratus™ Communicators at very low angles of elevation, that is, at horizon distances as far as 350 miles from a large city, there will be a five inch mini-dish antenna to maintain communications with a Sky Station™. This 36 dBi antenna must be permanently mounted with a clear line-of-site, but it will have nearly the same half power beamwidth as a DirecTV dish, and will therefore be just as easy to install. In the FAC zone, Stratus™ dishes will also be capable of rotating in azimuth, and modestly in elevation, in order to lock-on to the strongest Sky Station™ signal. Hence, SSI uses site (geographic) diversity to overcome propagation challenges at 47 GHz.

C. Technical Description of All Telecom Links

Each Sky Station™ platform is designed to service three different coverage zones: High Area Coverage (HAC), Wide Area Coverage (WAC), and Footprint Area Coverage (FAC). SSI has architected its GSTS system to provide highly useful and low-cost telecommunications services, notwithstanding the severe challenges of the 47 GHz band, by relaxing the 99.9% availability constraint engineered into most wireline and fixed satellite systems to a 98% availability figure. This 98% availability figure is still much higher than most people even in developed countries expect from a mobile or portable communications system, and is much higher than most people in developing countries can achieve from their wireline systems.

At 98% availability there is virtually nowhere in the world where the atmospheric attenuation (water vapor plus gas) at 48 GHz exceeds 1.1 dB/km of path length up to the freezing height.^{6/} In other words, since more than 90% of the attenuation is due to water, the propagation tables show there is virtually nowhere in the world that receives more than about 2.8 mm/hr of rainfall (1.1 dB/Km loss) for more than 2% of the year, or about 180 hours out of the 9000 hour year. While 2% outage is unacceptable for television broadcasting and certain other communication systems, SSI believes it is a reasonable penalty to accept as part of a low-cost wide-band telecommunications system that fills a complete void. Furthermore, it must be emphasized that this 2% outage figure is a worst case number -- in the vast majority of the world, 2.8 mm/hr rainfalls occur less than 1% of the time.^{7/} Accordingly, SSI has engineered its system to include, in the worst case, 1.1 dB/km of propagation margin for atmospheric losses through rain cells.

SSI's platforms will be geostationary at an altitude of 30 kilometers above the earth. From this altitude, the propagation margins for atmospheric losses and coverage areas associated with SSI's three grades of service are shown below:

^{6/} W.L. Pritchard. Satellite Communications System Engineering, pp. 285-291.

^{7/} Id. at p. 288, Table 6-2.

<u>SERVICE GRADE ZENITH</u>	<u>MIN ANGLE ELEVATION</u>	<u>PROPAGATION MARGIN</u>	<u>COVERAGE DISTANCE AREA</u>	<u>TO</u>
HAC	30 Degrees	9 dB	7,500 sq. km	50 km
WAC	10 Degrees	23 dB	77,000 sq. km	160 km
FAC	Horizon	28 dB	1 million sq. km	600 km

The atmospheric loss propagation margin is substantially less than the range to a Sky Station™ multiplied by the 1.1 dB/Km loss figure. The reason is that over 90% of the atmospheric loss occurs due to water located in rain cells that are of very limited size, much smaller than the range to a Sky Station™. Also, most FAC users will be in the FAC of more than one Sky Station™ and can use site diversity to select the path with fewest rain cells.

With regard to the HAC service grade, simple cellular user terminals will be able to directly access the Sky Station™, as shown in the link budget provided below. As to the WAC, users will have the option of accessing the Sky Station™ directly via a modest gain antenna or indirectly via a frequency coordinated relay transmitter that different countries may decide to authorize. Finally, in the FAC zone, users will have the option of accessing the Sky Station™ directly via a high gain antenna indirectly via a nationally coordinated relay transmitter. High gain antennas for FAC zone reception will also be capable of rotating to access the Sky Station™ with the best propagation conditions. For example, if rain conditions are worse for one particular Sky Station™ path, the SSI FAC earth station can shift to another Sky Station™ that has overlapping FAC coverage. It is important to note that as additional Sky Stations™ are deployed,

users will often find themselves having WAC replace their FAC, and HAC replace their WAC.

1. Downlink Budget (Sky Station™ to User)

The downlink budget assumes an information rate of 64 Kbps with FEC encoding and the following Modulation Parameters:

MODULATION PARAMETERS

2/3 rate K=7	96 Kbps convolutional
Reed Solomon	106 Kbps for 10% depth
QPSK:	56 Ksym/sec
Occupied Bandwidth:	67 KHz
Channel Bandwidth:	70 KHz
E_b/N_0 for 10^{-5} BER	6 dB

(soft decision 5 bits with coherent demodulation)

Power of 400 milliwatts is provided in the FAC region as compared to the 100 milliwatts in the HAC and WAC regions. As noted earlier, each cell in the Stratospheric Payload will have the ability to receive an allocation of greater power. This can be used to increase capacity, or to help overcome the particular moisture environment of particular cells, or to reduce antenna gain requirements.

The downlink budget is as follows:

DOWNLINK BUDGET

<u>Parameter</u>	<u>HAC Value</u>	<u>WAC Value</u>	<u>FAC Value</u>
Power/User	100 mW	100 mW	400 mW
	-10 dBW	-10 dBW	-4 dBW
Platform Gain	32 dBi	32 dBi	32 dBi
Slant Range	58 km	164 km	600 Km
Free Space Loss	-162 dB	-171dB	-183 dB
User Gain	<u>3 dBi</u>	<u>23 dBi</u>	<u>36 dBi</u>
Power Received	-137 dB	-126 dB	-119 dB
Power Noise	-153	-153	-153
C/N	16 dB	27 dB	34 dB
Required Eb/No for 64 Kbps 10 ⁻⁵ BER	<u>6 dB</u>	<u>6 dB</u>	<u>6 dB</u>
Margin, down for Propagation Losses	10 dB	21 dB	28 dB

The downlink budget from the Sky Station™ to the Base Station is essentially the same as above, except that only a small amount of power, about half a milliwatt, is allocated to each user since a high gain antenna may be implemented at the base station. The resultant margin can be set as high as necessary to handle the anticipated downlink traffic load.

2. Uplink Budget (User to Sky Station™)

The uplink budget for SSI's GSTS system is set by the need to keep user terminal power in the HAC region as low as possible to minimize battery power requirements and to respect radiation hazard limits. Accordingly, the user terminal uplink power has been set at 100 milliwatts (0.1 watts). Higher power is acceptable in the FAC zone because the transmitter itself is not portable but is instead affixed to a mini-earth station outdoors or by a window. The following uplink budget results for the high angle, wide angle and footprint angle coverage regions, assuming the same modulation characteristics provided in section (a) above.

UPLINK BUDGET

<u>Parameter</u>	<u>HAC Value</u>	<u>WAC Value</u>	<u>FAC Value</u>
Power/User	100 mW	100 mW	400 mW
	-10.0 dBW	-10.0 dBW	-4.0 dBW
User Ant. Gain	3.0 dBi	23 dBi	36 dBi
Occup. Bandwidth	70 KHz	70 KHz	70 KHz
Slant Range	58 km	164 km	600 Km
Free Space Loss	-162 dB	-171 dB	-183 dB
Platform Gain	<u>32 dBi</u>	<u>32 dBi</u>	<u>32 dBi</u>
P_R	-137 dB	-126 dB	-119 dB
P_N	-153 dB	-153 dB	-153 dB
C/N	16 dB	27 dB	34 dB
Data Rate	64 kbps	64 kbps	64 kbps
Required E_b/N_0	6 dB	6 dB	6 dB
Atmospheric Propagation Margin, down	10 dB	18 dB	28 dB

The uplink budget from the Base Station to the Sky StationTM is essentially the same as above, except that even higher gain antennas may be used to achieve as high a margin as is necessary.

3. Geographic Coverage to at Least 80% of World's Population

SSI's Sky Station™ GSTS system will cover all of the world's major metropolitan areas and at least 80% of the world's population. This coverage objective will be accomplished with 250 Sky Stations™ implemented over a five year period at the rate of 50 per year. Each Sky Station™ will be positioned over one of the 250 largest metropolitan areas. Each provides WAC to approximately 77,000 square kilometers of area, and FAC to one million square kilometers. SSI's research shows that 4.5 billion people live within 60 million square kilometers of the earth's surface area.

Correspondingly, 250 Sky Stations™ will provide WAC to about 15 million square kilometers, representing the roughly one billion people that live in metropolitan areas, and FAC to the rural remainder of 80% of the world's population. Within SSI's FAC and WAC contours, the highest density populations will receive HAC.

Each Sky Station™ coverage area will consist of approximately 2,100 cells, with cells becoming larger as they emanate outward from zenith. The approximately 700 cells in the HAC region will have an average size of five square miles. The average cell size will be fifty square miles in the WAC region and 500 square miles in the FAC region. Approximately 700 cells will receive High Angle Coverage, while another 700 cells will enjoy Wide Angle Coverage. The remaining cells will fall within the Footprint Angle Coverage contour. Each cell will receive a bandwidth assignment of one-seventh of the bandwidth allocated to the user links in the SSI system. The cells will share the bandwidth in a hexagonal frequency reuse pattern to avoid adjacent cell co-frequency operation. Power and bandwidth will be dynamically assigned to cells based on channel

demand, subject to overall power and bandwidth reuse limitations. Base station bandwidth will also be geographically reused within each Sky Station™ in a similar hexagonal pattern. Base station bandwidth may also be reused among different GSTS operators assuming adequate spatial separation of their locations.

Attachment 1 to this Application provides the locations (latitude and longitude) of the Sky Station™ GSTS system's 250 deployment positions. Attachment 2 to this Application shows the associated coverage contour for each position shown in the 600 mile radius circles, representing a near horizon point for SSI's FAC grade of service. FAC coverage contours are able to overlap without frequency interference due to the high directionality of the communication links in the FAC zone

D. Technical Description of Operations

The operations of the Sky Station™ GSTS system consist of three main phases for each Sky Station™ platform -- Deployment, Maintenance and Replacement/Retirement. These operations will all be undertaken in full compliance with all applicable FAA regulations.

1. Deployment

SSI intends to deploy Sky Stations™ at the rate of one per month in 1999, increasing to three per month in 2000 and four per month from 2001 until worldwide coverage is complete. Deployment will occur from rocket launch sites already pre-cleared with the FAA. Each deployment will take approximately 24 hours. Commercial airline-type practices will be followed to reduce the costs of deployment.

2. Maintenance

The Sky Station™ GSTS system will be designed to require no maintenance for over ten years, but provision will be made for unexpected maintenance requirements. Once telemetry indicates that multiple redundant systems have failed, a Sky Station™ will be commanded through the telecommand link to lower its altitude to a point where it can be grasped by helicopters equipped with sky hooks and taken to a deployment site. From that site the payload can be removed and taken to its vendor for refurbishment.

3. Replacement and Retirement

Sometime after the initial ten-year period, it will be necessary to replace and retire Sky Stations™. The reasons for this include decomposition of the gas-storage modules, decreased solar panel output, and structural fatigue. In addition, rapid advances in high strength, light-weight composite materials would likely be used in newer generations of Sky Stations™. SSI will begin retiring and replacing its Sky Stations™ in 2008, approximately ten years after initial deployment.

4. Back-ups and Redundancy

The Sky Station™ implementation plan makes it unnecessary to keep spare, redundant Sky Stations™ in the stratosphere. The reason for this is that a new Sky Station™ will be deployed every week, and should an operating Sky Station™ begin to fail, the next Sky Station™ would serve as a replacement platform rather than to extend coverage to a new area. Extension of coverage would be delayed by only a week. Once all 250 Sky Stations™ are in place, several back-ups will be built so that a replacement could always be deployed on one week's notice.

E. Implementation Milestones

SSI has adopted the following milestone schedule for the implementation of its Sky Station™ GSTS System:

<u>Months After Receipt of Final FCC Approval</u>	<u>Sky Stations Launched</u>	<u>Percent of World Population Covered</u>
24	50	5%
36	100	20%
48	150	40%
60	200	60%
72	250	80%

F. Services Provided

The Sky Station™ GSTS system will provide broadband fixed, mobile and portable digital switched services worldwide, especially in areas of significant population density. The Sky Station™ system has been designed to provide access to the Internet's World Wide Web at 64 kbps data rates, as well as with compressed picturephone service. Depending on the user's coverage area, the Sky Station™ services may be accessed from a handheld cellular phone-like device (High Angle Coverage Area), or from a small notebook computer like device (Wide Angle Coverage Area), or from a soup bowl size satellite dish (Footprint Angle Coverage Area).

For all services, SSI has sized its GSTS system to be able to make a profit for its shareholders while charging customers approximately ten cents per minute. This pricing target for broadband portable service is desirable both to differentiate SSI from

other services and to bring the full breadth of GSTS services to a much greater worldwide population than has been the case to date.

Customers will be asked to pay a minimum monthly subscription fee as a non-refundable credit toward their actual communications usage fee. Once this fee is paid, the Sky Station™ system will update its switching centers with the information that a paid-up customer's serial ID number is fully active. Subscription fee collection and obtaining serial ID number information will be the responsibility of a national service provider in each country.

Security features built into the Stratus™ Communicator will emulate those of cellular and personal communications services. There will be password protection for access to the Internet Web capability. Theft of service can be prevented with the Stratospheric Station™ system because all signals pass through a Sky Station™ switch. This switch may be located onboard each Sky Station™ or at a ground switching center, based on further operational analyses. In either event, by notifying Sky Station™ customer service that a monthly bill is incorrect and appears to indicate theft of service, the Sky Station™ system will be able to block any further calls using the suspect Stratus™ Communicator ID number. If a person's Stratus™ Communicator is stolen, they only need to report the event and their billing name to Sky Station™ customer service. The stolen Communicator's ID number will be deactivated at all Sky Station™ switches.

G. Frequency of Operation

Sky Station™ would use frequencies in the 47.2-47.5 GHz band for earth-to-stratosphere transmissions and in the 47.9-48.2 GHz band for stratosphere-to-earth transmissions. Base station feeder links and TTC links will be accommodated with the earth-to-stratosphere links by frequency separators.

II. SSI'S QUALIFICATIONS

A. Technical Qualifications

SSI's GSTS Sky Station™ system described in this Application will be capable of delivering GSTS to more than 80% of the world's population. SSI's proposed system also could be expanded through the construction and deployment of additional Sky Stations™ after the initial 250 platform deployment is complete. In this manner, the Sky Station™ system could reach an even greater percentage of the world's population and at higher angles of elevation with a negligible, if any, increase in cost to customers. SSI's schedule for construction and deployment of its system is provided in Attachment 3.

B. Financial Qualifications

1. The Cost of the System

SSI projects that deployment of its entire system through 2005 will cost a total of \$4.2 billion, although the investment cost will be only \$1.975 billion because net income from the earlier launched Sky Stations™ will cover the costs of later Sky Stations™. Construction and deployment of the first Sky Station™ platform in 1998 will cost \$35 million and the remaining 249 platforms will cost an average of \$15 million, for a total platform cost of \$3.77 billion. SSI estimates that its ground station network will

cost a total of \$250 million and that other costs will total \$180 million. The Sky Station™ system costs will be funded from equity (\$975 million), debt (\$1.0 billion), and retained earnings (\$2.225 billion). SSI will incur its costs over a period of 10 years running from 1998 through 2005 and estimates that its budgets for each year will be as follows:

<u>Year</u>	<u>Costs (in millions)</u>
1998	\$ 250
1999	\$ 750
2000	\$ 750
2001	\$ 750
2002	\$ 750
2003	\$ 500
2004	\$ 250
2005	\$ 200

2. SSI's Financial Qualifications

SSI has requested the Commission to require applicants to commit sufficient funds to the development of a GSTS system to construct, deploy and operate one stratospheric platform for one year in order to be financially qualified. SSI will be able to construct, deploy and operate Sky Station™. Its financial and industrial backers currently include General Alexander M. Haig, Jr. and his firm Worldwide Associates, Inc., Chicago industrialist William Wood Prince, and Team Technologies, Inc., all of whom have or have access to substantial resources and have extensive experience in

building and financing new companies here and abroad. SSI also has obtained a letter from the World Bank supporting the development of Sky Station™ and its GSTS proposal included here as Attachment 4. SSI intends to amend its application to further demonstrate its financial qualifications prior to the close of the first GSTS application filing window. SSI is working with several investment banking firms to review its outside financing needs, assist in implementing its funding plan, and structure future debt and equity placements.

C. Legal Qualifications

SSI's legal qualifications are set forth in the FCC Form 430 Licensee Qualification Report contained in Attachment 5.

D. Legal Contacts

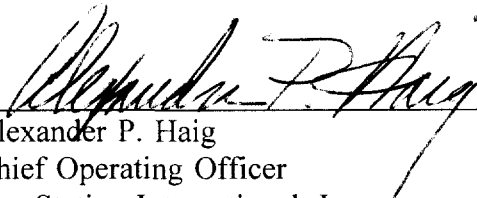
For questions about this application, please contact Martine Rothblatt, Paul A. Mahon, or Christopher Patusky of Mahon & Patusky, Chartered, 1735 Connecticut Avenue, N.W., Washington, D.C. 20009 (202-483-4000) or Jonathan D. Blake or Lee J. Tiedrich of Covington & Burling, 1201 Pennsylvania Avenue, N.W., P.O. Box 7566, Washington, D.C. 20044-7566 (202-662-6000).

CONCLUSION

WHEREFORE, based on the foregoing, Sky Station International, Inc. has established that it is legally, financially, technically otherwise qualified to construct, deploy and operate the proposed system and that grant of this Application will serve the public interest, convenience and necessity. Sky Station International, Inc. requests that the Commission grant this Application and authorize the construction, deployment and operation of its Global Stratospheric Telecommunications System.

Respectfully submitted,

SKY STATION INTERNATIONAL, INC.

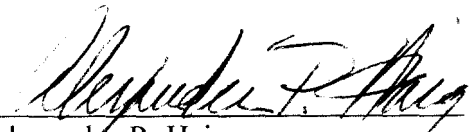
By: 
Alexander P. Haig
Chief Operating Officer
Sky Station International, Inc.
3810 Concorde Parkway, Suite 1600
Chantilly, Virginia 22021

Dated: March 20, 1996.

ANTI-DRUG ABUSE ACT CERTIFICATION

I, Alexander P. Haig, hereby certify, under penalty of perjury, that no party to this application, as defined in Section 1.2002(b) of the Commission's rules, 47 C.F.R. §1.2002(b), is subject to a denial of federal benefits pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C. § 853a.

Sky Station International, Inc.

By: 
Alexander P. Haig
President and Chief Operating Officer

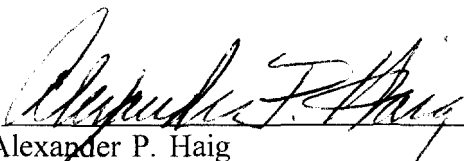
Dated: March 20, 1996

CERTIFICATION

All statements made in this Application and in the associated attachments are a material part hereof, and are incorporated herein as if set out in full in this Application.

The undersigned certifies individually and for Sky Station International, Inc. that the statements made in this Application are true, complete and correct to the best of his knowledge and belief, and are made in good faith.

Sky Station International, Inc.

By: 
Alexander P. Haig
President and Chief Operating Officer

Dated: March 20, 1996

CERTIFICATION OF PERSON RESPONSIBLE
FOR PREPARING ENGINEERING INFORMATION
SUBMITTED IN THIS APPLICATION

I, Dr. Alfred Y. Wong, am the Executive Vice President and Chief Scientist of Sky Station International, Inc. ("SSI") and inventor of the Corona Ion Engine.TM

I hereby certify that I am the technically qualified person responsible for preparation of the engineering information contained in this Application, and the exhibits, attachments, and appendices associated and attached hereto; that I have either prepared or reviewed the engineering information submitted in this Application and the exhibits, attachments, and appendices thereto, and that it is complete and accurate to the best of my knowledge, information and belief.

Dated this 19th day of March, 1996.

SKY STATION INTERNATIONAL INC.



Dr. Alfred Y. Wong
Executive Vice President
and Chief Scientist

SKY STATION™ GEOGRAPHIC COORDINATES

SKY STATION LOCATIONS

Asia	N/S	E/W
	33 37N	139 45E
	31 15 N	121 28E
	39 75N	116 23E
	22 33N	88 22E
	34 45N	135 30
	37 35N	127 00E
	19 00N	72 50E
	19 00N	118 24E
	6 15S	106 60E
	15 00N	121 00E
	35 70N	51 48E
	28 37N	77 13E
	22 17N	114 50E
	25 05N	67 10E
	13 30N	100 32E
	13 20N	80 46E
	42 60N	130 00E
	10 90N	107 00E
	23 75N	90 20E
	33 45N	44 00E
	28 50N	119 00E
	35 04N	129 01E

19 90N	120 10E
31 32N	74 22E
12 00N	87 00E
21 05N	105 55E
37 50N	107 05E
44 75N	130 55E
22 00N	73 80E
17 10N	88 05E
1 17N	103 53E
33 30N	36 18E
31 10N	105 00E
16 45N	96 17E
25 04N	121 35E
8 05S	111 50E
36 30N	118 00E
31 05N	113 30E
30 90N	123 00E
34 95N	137 00E
41 20N	69 09E
4 20N	98 10E
6 56N	79 58E
37 06N	117 50E
43 85N	125 00E
17 70N	74 85E

7 10S	107 20E
43 00N	141 21E
34 40N	136 40E
36 95N	126 95E
25 00N	103 70E
36 05N	104 10E
34 45N	113 38E
22 19N	91 48E
50 00N	35 00E
39 37N	118 05E
36 40N	117 00E
26 35N	106 40E
32 04N	34 48E
20 10N	79 50E
56 52N	60 35E
39 00N	125 30E
21 00N	106 90E
7 15S	110 50E
22 36N	120 17E
47 23N	124 00E
36 20N	43 08E
41 05N	122 58E
24 55N	46 70E
30 18N	120 07E

36 04N	120 22E
33 39N	130 21E
26 09N	119 17E
32 44N	35 19E
55 00N	73 22E
31 25N	73 09E
55 12N	61 25E
37 30N	126 38E
28 10N	113 00E
43 53N	126 35E
38 10N	114 00E
35 32N	139 41E
33 52N	130 49E
43 19N	76 55E
28 40N	115 50E
40 38N	109 59E
34 31N	69 12E
26 35N	75 50E
26 50N	80 54E
47 54N	106 52E
3 08N	101 42E
33 40N	73 08E
34 23N	132 27E
32 41N	51 41E
31 47N	35 10E